

1 WHAT IS CLAIMED IS:

1 1. A method for manufacturing a bipolar transistor of the
2 type comprising a base, an emitter and a collector formed on a
3 substrate, said method comprising the steps of:
4 etching a trench in said substrate between a first area for
5 forming a base and an emitter (base/emitter area) and a second area
6 for forming a sinker and a collector;
7 doping a portion of said substrate in said second area to
8 form a sinker and collector layer comprising a sinker portion and
9 a collector portion; and
10 establishing a value of breakdown voltage for said bipolar
11 transistor by causing a distance of said collector portion from
12 said first area (base/emitter area) to have a selected value.

1 2. The method as set forth in Claim 1 wherein said step of
2 doping a portion of said substrate to form a sinker and collector
3 layer comprising a sinker portion and a collector portion comprises
4 the steps of:

5 implanting dopant in a portion of said substrate at the bottom
6 of said trench to create said collector portion of said sinker and
7 collector layer; and

8 implanting dopant in a portion of said substrate that is

9 located adjacent to said collector portion but not in said trench
10 to create said sinker portion of said sinker and collector layer.

1 3. The method as set forth in Claim 2 further comprising the
2 step of:

3 applying a heat treatment to diffuse dopant in said sinker
4 portion into adjacent substrate areas and to diffuse dopant in said
5 collector portion into adjacent substrate areas until said sinker
6 portion and said collector portion are joined to form said sinker
7 and collector layer.

1 4. The method as set forth in Claim 3 further comprising the
2 step of:

3 terminating said heat treatment when said dopant in said
4 sinker portion diffuses laterally under said trench to a desired
5 distance from said first area (base/emitter area).

1 5. The method as set forth in Claim 1 further comprising the
2 step of:

3 etching said trench to a depth that optimizes a value of
4 resistance of said bipolar transistor versus breakdown voltage of
5 said bipolar transistor.

1 6. The method as set forth in Claim 1 wherein said step of
2 establishing a value of breakdown voltage for said bipolar
3 transistor by causing a distance of said collector portion from
4 said first area (base/emitter area) to have a selected value
5 comprises the steps of:

6 placing a collector and sinker mask over a portion of said
7 trench that is adjacent to said first area; and

8 selecting a lateral extent of a horizontal portion of said
9 collector and sinker mask to control a distance of a subsequent
10 lateral diffusion of said collector portion from said first area
11 (base/emitter area).

1 7. The method as set forth in Claim 6 wherein said lateral
2 extent of said horizontal portion of said collector and sinker mask
3 is selected so that a subsequent lateral diffusion of said
4 collector portion does not extend into a portion of said
5 substrate layer that is located within a specified distance from
6 a wall of said trench that is adjacent to said first area
7 (base/emitter area).

1 8. The method as set forth in Claim 7 wherein said specified
2 distance is a distance that optimizes a value of resistance of said
3 bipolar transistor versus breakdown voltage of said bipolar
4 transistor.

1 9. A bipolar transistor of the type comprising a base, an
2 emitter and a collector formed on a substrate, said bipolar
3 transistor comprising:

4 a trench etched in said substrate between a first area for
5 forming a base and an emitter and a second area for forming a
6 sinker and a collector; and

7 a portion of said substrate in said second area doped to
8 form a sinker and collector layer comprising a sinker portion and
9 a collector portion;

10 wherein a length of said collector portion is formed having a
11 selected distance from said first area (base/emitter area) to
12 establish a selected value of breakdown voltage for said bipolar
13 transistor.

1 10. The bipolar transistor as set forth in Claim 9 wherein
2 said sinker and collector layer comprises:

3 a portion of said substrate at the bottom of said trench that
4 is doped to create said collector portion of said sinker and
5 collector layer; and

6 a portion of said substrate that is located adjacent to said
7 collector portion but not in said trench that is doped to create
8 said sinker portion of said sinker and collector layer.

1 11. The bipolar transistor as set forth in Claim 10 further
2 comprising:

3 said sinker portion having dopant diffused into adjacent
4 substrate areas and said collector portion having dopant diffused
5 into adjacent substrate areas wherein said diffused dopant joins
6 said sinker portion and said collector portion to form said sinker
7 and collector layer.

1 12. The bipolar transistor as set forth in Claim 11 further
2 comprising:

3 said collector portion having dopant that has diffused
4 laterally under said trench to a desired distance from said first
5 area (base/emitter area).

1 13. The bipolar transistor as set forth in Claim 9 wherein
2 said trench is etched to a depth that optimizes a value of
3 resistance of said bipolar transistor versus breakdown voltage of
4 said bipolar transistor.

1 14. The bipolar transistor as set forth in Claim 9 wherein
2 said distance of said collector portion that is formed having a
3 selected distance from said first area (base/emitter area) to
4 establish a selected value of breakdown voltage for said bipolar
5 transistor is determined by:

6 placing a collector and sinker mask over a portion of said
7 trench that is adjacent to said first area; and

8 selecting a lateral spacing of a horizontal portion of said
9 collector and sinker mask from said first area (base/emitter area)
10 to control a length of a subsequent lateral diffusion of said
11 collector portion.

1 15. The bipolar transistor as set forth in Claim 14 wherein
2 said lateral spacing of said horizontal portion of said collector
3 and sinker mask is selected so that a subsequent lateral diffusion
4 of said collector portion does not extend into a portion of said
5 substrate layer that is located within a specified distance from
6 a wall of said trench that is adjacent to said first area
7 (base/emitter area).

1 16. The bipolar transistor as set forth in Claim 15 wherein
2 said specified distance is a distance that optimizes a value of
3 resistance of said bipolar transistor versus breakdown voltage of
4 said bipolar transistor.

1 17. A bipolar transistor of the type comprising a base, an
2 emitter and a collector formed on a substrate, said bipolar
3 transistor comprising:

4 a trench etched in said substrate between a first area for
5 forming a base and an emitter (base/emitter area) and a second area
6 for forming a sinker and a collector; and

7 a sinker and collector layer comprising a sinker portion and a
8 collector portion formed by doping a portion of said substrate;

9 wherein a value of breakdown voltage for said bipolar
10 transistor is determined by a distance of said collector portion
11 from said first area (base/emitter area).

1 18. The bipolar transistor as set forth in Claim 17 wherein
2 lateral diffusion of dopant in said collector portion determines
3 said distance of said collector portion from said first area
4 (base/collector area).

1 19. The bipolar transistor set forth in Claim 18 wherein said
2 dopant in said collector portion at the bottom of said trench is
3 laterally diffused under said trench by heat treatment.

1 20. The bipolar transistor as set forth in Claim 18 wherein
2 a distance of said collector portion before dopant in said
3 collector portion laterally diffuses is determined by a length of a
4 horizontal portion of a collector and sinker mask.